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(54) IMPROVEMENTS IN OR RELATING TO HELICOPTERS

(71) We, WESTLAND AIRCRAFT LIMITED, of Yeovil, in the County of Somerset, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to helicopters.

One factor that limits the attainable forward speed of a helicopter is drag resulting from a blade stall condition which occurs when the pitch angle of a retreating blade of a lift rotor is increased beyond certain limits in an attempt to retain a lift component from the blade at high forward speeds. One known expedient for delaying the onset of such retreating blade stall is to fit fixed stub wings on the fuselage to provide lift to off-load the lift rotor system during forward flight, thereby increasing the maximum forward speed that can be achieved. However, the provision of fixed stub wings can be detrimental to the sustained hovering capabilities of the helicopter because the area of the wings is located in the downwash from the lift rotor system. A further cause of drag during forward flight is the fixed undercarriage and supporting members utilized in a large number of helicopter designs. Retractable undercarriages are not generally used because of the necessity to retract three or more undercarriage members into the fuselage, thereby further reducing the already somewhat limited volume available for useful payload.

According to the invention we provide a helicopter comprising a fuselage, a lift rotor system and wing sections extending from opposite sides of the fuselage, said wing sections being pivotable, relatively to the fuselage, about a spanwise axis between a first position in which their chords are substantially horizontal and a second position in which their chords are substantially vertical, the helicopter further comprising undercarriage means including a member carried by each wing section and protruding to the rear of the trailing edge thereof to be positioned for ground engagement when the wing sections are in said second position.

The invention will now be described by way of example only with reference to the accompanying drawings, in which:—

Figure 1 is a perspective view of a helicopter embodying the invention and showing the wing sections thereof in the said second, chord-vertical, position; and

Figure 2 is a perspective view of the helicopter of Figure 1 showing the wing sections in the said first, chord-horizontal, position.

The illustrated helicopter has a fuselage 11 of aerodynamic shape and a lift rotor system constituted by a main rotor head and blades 12, and an anti-torque tail rotor 13.

Port and starboard wing sections 14 extend from opposite sides of the fuselage 11, being mounted at the ends of a beam 15 that extends through the fuselage 11 and is mounted for rotation about its longitudinal axis so as thereby to accomplish pivoting movement of the wing sections about a spanwise axis. In Figure 1, the skin covering of the starboard wing section 14 is omitted to show the end of the beam 15 located within the main structural member of the wing section 14. A lever 16 has one end fixedly secured to a central region of the beam 15, the other end of the lever being articulated to the ram of a hydraulic jack 17 mounted in the fuselage 11.

An undercarriage member 18 including a ground-engaging wheel 19 is mounted at the tip of each wing section 14. Each undercarriage member 18 is faired by an aerodynamically shaped housing extending generally parallel with the wing section chord to support the ground-engaging wheel 19 in a position in which it protrudes beyond the trailing edge of the wing section. Shock absorber means are incorporated in each undercarriage member 18.

A third undercarriage member 20 having a pair of ground-engaging wheels 21 is pivotally mounted beneath a nose section of

the fuselage 11, and a hydraulic jack 22 is connected between the fuselage and the member 20 to provide for retraction of this undercarriage member into the fuselage. Shock absorber means are incorporated in the undercarriage member 20.

In the configuration shown in Figure 1 the wing sections 14 have their chords in a substantially vertical position in which the ground-engaging wheels 19 on the undercarriage members 18 form two-thirds of a tricycle undercarriage, completed by the ground-engaging wheels 21 on the undercarriage member 20. This is the configuration for vertical take-offs and landings and for operations involving extended hovering periods. The chord-vertical position of the wing sections 14 ensures that the surface area in the downwash from the main rotors is minimised and its effect on hovering performance is negligible.

In Figure 2 the main and tail rotor blades have been omitted for clarity and the skin covering of the port wing section 14 has been omitted to show the other end of the beam member 15.

After take-off and when fast forward flight is required, the hydraulic jack 22 is operated to retract the undercarriage member 20 into the nose section of the fuselage 11. Actuation of the hydraulic jack 17 moves the lever 16, to rotate the beam 15 and the wing section 14 from the chord-vertical position (Figure 1) to the chord-horizontal position (Figure 2), in which configuration the wing sections 14 provide a lift component in forward flight to carry some of the weight, thereby off-loading the lift rotor system and facilitating the achievement of higher operating speeds.

It will be appreciated that in tilting of the wing sections 14 the fixed undercarriage members 18 and ground-engaging wheels 19 are also moved through approximately 90° between an operational position (Figure 1) and a non-operational or retracted position (Figure 2). In this manner the drag penalty of these fixed undercarriage members is reduced to a minimum without the necessity of complicated and heavy retracting mechanisms and with no encroachment of the payload area of the helicopter. Operationally, the reduced drag penalty will significantly increase the speed capabilities of the helicopter.

Other advantages of the invention are low cost and weight due to the elimination of complicated operating mechanisms, improved ground stability due to the relatively wide track of the wheels 19, and a trim control facility which is possible by adjusting the incidence of the wing sections 14, thereby further enhancing the operational characteristics.

In come operational roles it is desirable to store helicopters in relatively confined spaces, and it is known to incorporate rotor blade fold mechanisms to facilitate such storage. In a helicopter embodying the invention, hinge means (not shown) may be fitted between the wing sections 14 and the fuselage 11, and fully castoring wheels fitted on the undercarriage members 18, so that when the wing sections 14 are in the chord-vertical position of Figure 1 they may be folded about the hinge means from the position shown in Figure 1 to a position adjacent to the sides of the fuselage 11, thereby significantly reducing the width to facilitate storage.

Although one embodiment only has been described and illustrated, it is to be understood that modifications can be made without departing from the scope of the appended claims. For instance, the tilt operating mechanism is not limited to that shown, and may be of any suitable form operated either hydraulically, electrically, or pneumatically. Each wing section 14 may be operated by independent means. Auxiliary propulsion means may be provided, and may be in the form of a jet engine separate from the main rotor drive engine or engines. The wing sections may be of unitary construction to form a single wing structure pivotally mounted beneath a lower surface of the fuselage. The undercarriage members 18 could be incorporated within the structure of the wing sections 14, and could therefore be located at any desired track width.

WHAT WE CLAIM IS:—

1. A helicopter comprising a fuselage, a lift rotor system and wing sections extending from opposite sides of the fuselage, said wing sections beoing pivotable, relatively to the fuselage, about a spanwise axis between a first position in which their chords are substantially horizontal and a second position in which their chords are substantially vertical, the helicopter further comprising undercarriage means including a member carried by each wing section and protruding to the rear of the trailing edge thereof to be positioned for ground engagement when the wing sections are in said second position.

2. A helicopter as claimed in Claim 1, wherein each said undercarriage member is mounted in an aerodynamically shaped housing at the tip end of its associated wing section.

3. A helicopter as claimed in Claim 1 or Claim 2, wherein said undercarriage members comprise wheels for ground engagement.

4. A helicopter as claimed in any preceding Claim, wherein the wing sections are mounted one at each end of a beam extending through the fuselage.

5. A helicopter as claimed in Claim 4,

wherein the beam is rotatable about its longitudinal axis for moving the wing sections about the said spanwise axis.

6. A helicopter as claimed in Claim 5, wherein a fluid motor is provided to effect rotation of the beam.

7. A helicopter as claimed in Claim 6, wherein the fluid motor comprises a hydraulic jack.

8. A helicopted as claimed in any preceding Claim, wherein the undercarriage members carried by the wing sections form two-thirds of a tricycle undercarriage.

9. A helicopter as claimed in Claim 8, wherein the tricycle undercarriage comprises a third undercarriage member, including a ground-engaging means, located beneath the fuselage.

10. A helicopter as claimed in Claim 9, wherein the third undercarriage member is retractable into the fuselage.

11. A helicopter as claimed in any preceding Claim, having shock absorber means incorporated in each said undercarriage member.

12. A helicopter as claimed in any preceding Claim, including hinge means enabling each wing section, when in its said second position, to be folded to a position adjacent to the side of the fuselage.

13. A helicopter substantially as described with reference to and as shown in the accompanying drawings.

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1394177 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

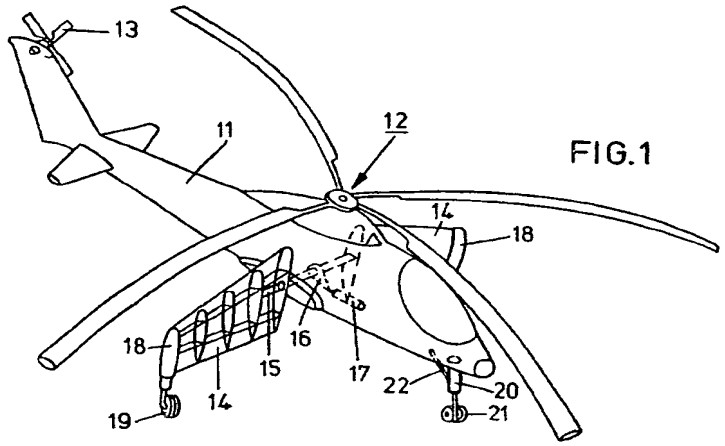

FIG.1

FIG. 2